ABSTRACT

In this paper, turning trial results in ice were compared with performance predicted from the model tests using a couple of test methods for an ARC7 LNG carrier. Because of the limited width of model basin, the turning circle is approximated from the measured track in the ice after the test is partially performed. The initial speed, the moment of the turning of the POD units, and releasing the model for the turning tests to be carefully decided to obtain the most reliable results. Two different ice-turning test methods with different approach speeds were carried out and figurred out the best one considering full scale performance. We will also discuss the reason for the difference in turning ability between the Port turn and the Starboard turn which was found during the object ship's ice-turning trial.

KEY WORDS: ARC7 LNG carrier, ice, turning radius

INTRODUCTION

Demand for the arctic vessels passing through the Northern Sea Route (NSR) is increasing with the growing oil and gas field development activities in the arctic region as well as due to the global warming (Skripnuk, D.F., Iliyushchenko, I.O., Kulik, S.V., Stepanova, M.M., 2020).

Good turning performance in ice is an essential ability for the arctic class vessels to escape from the emergency circumstances during the voyage in ice-covered region.

Turning performance tests in ice have two issues; one is regulatory and the other related to practical limitation of test facilities. In terms of regulation, it is clearly documented at what specific approach speed to be tested and the turning circle to be met for the open-sea-going merchant vessels (MSC.137(76); 2002). However, for the arctic vessels, it is noted (ITTC-Recommended Procedures and Guidelines 7.5-02-04-02.3; 2021) only for the turning model tests method and how to calculate the turning circle. No recommended turning abilities are specified for safe operation in the ice-covered regions. The required turning abilities of the arctic vessels have been decided based on the empirical practice of each ship operators. The other issue from the limited width of test facilities is uncertainties involved in predicting the turning circle by experiment. The turning circle can be measured with relatively high accuracy in the large square type of ice model basins that are spacious enough for full turning of ship models. Unfortunately, in the ice basins with narrow width that is true most of the time, it has to be carried out only for very initial part of turning and has to be extrapolated to a full turning circle, which can be largely affected by the trajectory estimation methods. Since there is no standard approach speed for the ice-turning model tests, it is often defined as the maximum ship speed available that is obtained from the self-propulsion tests in a certain thickness of level ice.

With the above issues in mind, two different model test methods were applied to an ARC7 LNG carrier to find out the better one giving a fairly reasonable turning circle that would be comparable to the ice trial results.

We also found a better performing configuration of pod angles for the best performance through the trial-and-error method.

OBJECT VESSEL

The object vessel for the study is a high arctic class (Arc7) 172,000M³ LNG carrier supporting Yamal gas field. Table 1 shows the main particulars of the Arc7 LNG carrier. The vessel is equipped with three pod propulsion systems with total 45MW of installed power.